Multiplicity scaling of light nuclei production in relativistic heavy-ion collisions

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Using the nucleon coalescence model based on kinetic freeze-out nucleons from the 3D MUSIC+UrQMD [1] and the 2D VISHNU [2] hybrid model with a crossover equation of state, we have studied the multiplicity dependence of deuteron (d) and triton (t) production from central to peripheral Au+Au collisions at $\sqrt{s_{NN}} = 7.7$, 14.5, 19.6, 27, 39, 62.4 and 200 GeV and Pb+Pb at $\sqrt{s_{NN}} = 2.76$ TeV [3]. We have found that the ratio N_tN_p/N_d^2 of the proton yield N_p, deuteron yield N_d, and triton yield N_t exhibits a scaling behavior in its multiplicity dependence, i.e., decreasing monotonically with increasing charged-particle multiplicity, as shown in Fig. 1. A similar multiplicity scaling of this ratio is also found in the nucleon coalescence calculation based on kinetic freeze-out nucleons from a multiphase transport (AMPT) model [4]. The scaling behavior of N_tN_p/N_d^2 can be naturally explained by the interplay between

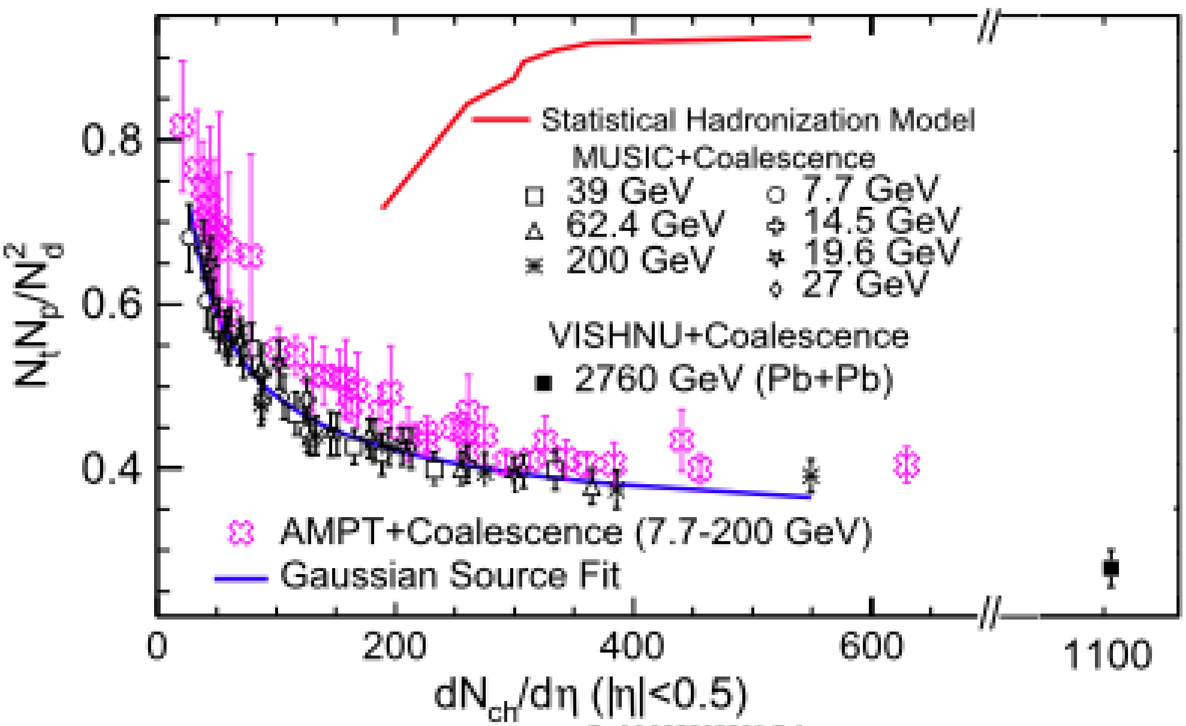

Fig. 1. Multiplicity dependence of the yield ratio N_tN_p/N_d^2 in Au+Au collisions at $\sqrt{s_{NN}} = 7.7$ - 200 GeV and Pb+Pb collisions at $\sqrt{s_{NN}} = 2.76$ TeV calculated from the nucleon coalescence model using kinetically freeze-out nucleons from the MUSIC+UrQMD [1], VISHNU [2] and AMPT [4] models, as well as the statistical model that includes only stable nuclei [5]. Also shown by the blue solid line is the result from fitting the results of MUSIC+UrQMD hybrid model with the mutiplication factor p_0 = 0.683 and using the relation $R = 0.547(dN_{ch}/d\eta)^{0.331}$ fm between the radius R and the charged particle multiplicity $dN_{ch}/d\eta$ of the nucleon emission source.

the sizes of light nuclei and the nucleon emission source. We further argue that the multiplicity scaling of $N_t N_p/N_d^2$ can be used to validate the production mechanism of light nuclei, and the collision energy dependence of this yield ratio can serve as a baseline in the search for the QCD critical point in relativistic heavy-ion collisions.

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